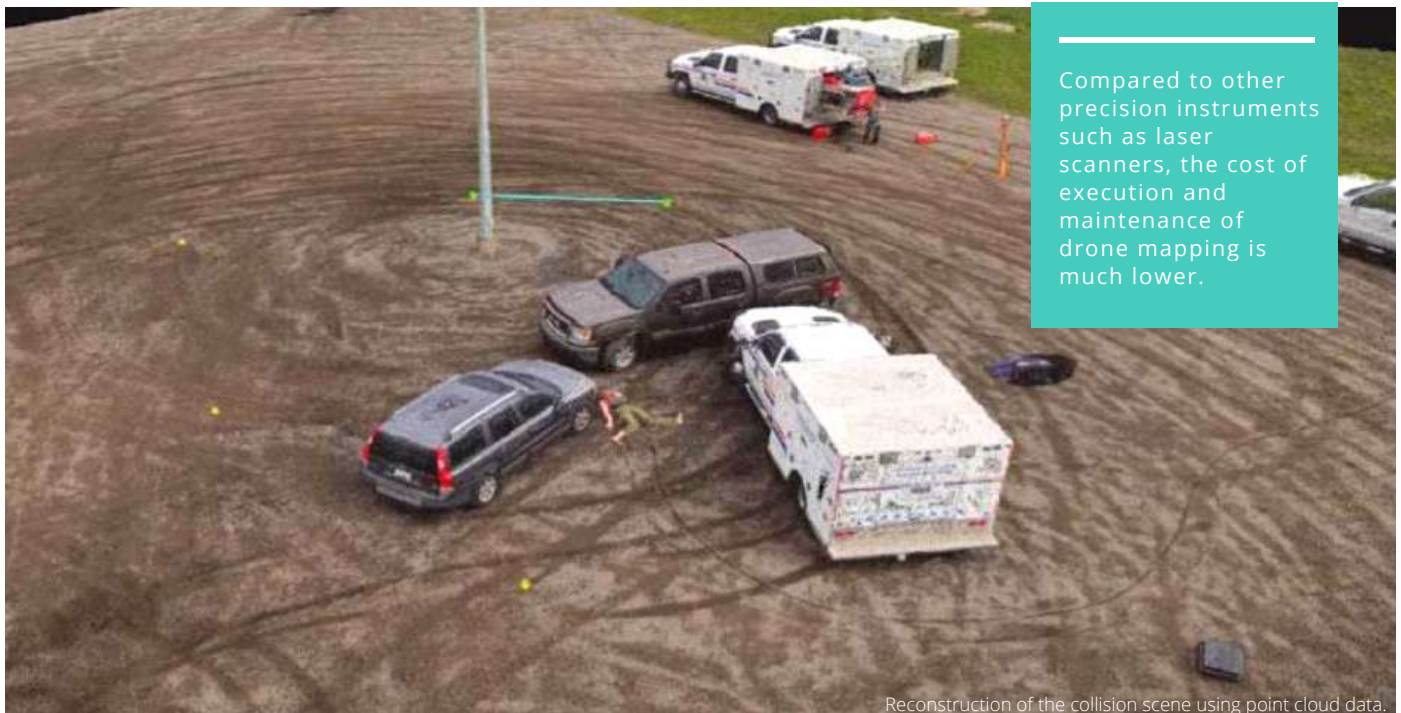


# DRONE PHOTOGRAMMETRY TO DOCUMENT VITAL EVIDENCE OF FORENSIC INVESTING

Using drones and Pix4Dmapper to reconstruct accident and crime scenes provides an immediate response, saves time and expense and offers highly accurate outputs.

by Pix4D



Reconstruction of the collision scene using point cloud data.

Over the last few decades, forensic investigators as embrace the geospatial technologies in decoding the crucial puzzles in forensic investigations. The latest developments in Geospatial technologies have given the capability to recreate the entire after collision or crime scene as-is in 3D. The 3D modelling helps in the visualization – what exactly happened, analysing – how it could happen, to collect vital evidence for forensic investigation, documentation and to ensure justice.

Geospatial technologies have unique capabilities which are ideally suited

to collecting and analyzing spatial data. Traditional methods of investigation, such as pin maps, are largely unable to cope with volumes of multifaceted spatial information in any meaningful manner capable of assisting in identifying an offender or excluding possibilities. One of the most basic but crucial inputs in a forensic investigation the location and spatial correlation among various objects at the crime site. The use of geospatial technologies helps to support forensic investigations by storing data in correlations with spatial information and reproduce the entire scene to establish facts at any time. As a result, the concepts of

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location, place, and scale are intrinsically embedded within forensic investigations, analyses, and through the presentation of evidence, as are spatio-temporal relationships.<sup>1</sup>

It's been decades that photogrammetry has been used for generating 2D and 3D mapping outputs. Along with the surge of drone usage, acquiring geospatial data has become faster and easier, with drastically increased resolution.

Law enforcement agencies and forensic investigators can easily create a detailed 3D model of the crime scene with a drone, a mobile application - Pix4Dcapture, and an image processing software - Pix4Dmapper. Pix4Dcapture allows to choose the flight plans according to mapping targets, and it automatically controls the drone and triggers the camera on-board referring to the requirement on overlaps, ground sampling distance, and many more.

Once the flight is completed, use the Pix4Dmapper desktop software to reconstruct the mapping outputs locally and experience more functionalities with a full 3D view in Pix4Dmapper Pro's raycloud – a unique, interactive interface displaying 2D image - 3D reconstruction correlations.<sup>2</sup>

### Collision and Crime Scene Investigation with Drones

The Royal Canadian Mounted Police has started using Unmanned Aerial Vehicles to help them with their work on collision and crime scene investigations. It allows the investigations to be conducted under all weather conditions and provides broader views than the traditional procedures.

In an experimental project<sup>3</sup> which was organized by the Royal Canadian Mounted Police (RCMP) and Pix4D, using UAV models from Draganfly and Aeryon Labs. Two data sets of a made-up crime scene were acquired with quadcopters images of a staged car accident scene from low

altitude. The ground sampling distance was less than 1 cm in order not to miss any details. A total of 225 images from Aeryon Labs and 212 images from Draganfly were obtained during the flights.

The full flight took less than thirty minutes including the pre-flight preparation. Eight yellow evidence markers were placed around the collision scene, indicating the location where all evidence was found.

A few on-site measurements were made by the police. GPS measurements of the object corners and the evidence markers were used as ground control points, and tape measurements between the markers were recorded for further assessment of the results.

The images were processed by Pix4Dmapper to reconstruct the 3D scene. Pix4Dmapper's total processing time was approximately two hours on a laptop with a core i7 and 8GB RAM. A densified point cloud, digital surface model (DSM) and orthomosaic were generated. Annotation and measurements were directly made in the software user interface.

The reconstructed results either exactly match or are within one centimeter accuracy when compared with traditional methods (tape measurements and laser scanner).

### No-Light or Night-Time Crime Scene Documentation Using Drone

With drone technology and Pix4Dmapper photogrammetry software, a scene can be investigated and documented in as little as 20 minutes in the right conditions – but challenging conditions can slow things down, potentially allowing vital information to be lost.

Lighting is one of the biggest challenges facing public safety personnel. Low or no light can mean blurry or too-dark images which may require color correcting or even lose vital data. Adding light with flashlights or standard floodlights can cast harsh shadows.

To set the scene,<sup>4</sup> teams from FoxFury, Pix4D, Sundance Media Group (SMG), and the Nevada Drone Center of Excellence used actors, fake blood and bullet casings to create a realistic incident. The location did not have any lighting (or for that matter, any electricity to power floodlights). A lighting system from FoxFury Nomad Hi CRI was used to create a no/low-shadow environment with accurate colors. This system can be mounted to many different drones, including the DJI Phantom, Inspire 1, Inspire 2, Matrice 200 series, and produce daylight-like light even on the darkest nights.

Ground Control Points were laid into place on the perimeter of the scene,



Figure 1: Dummy was used to create the demo crime scene.

taking care to ensure no one stepped into the scene. These are used as tie-points during the 2D and 3D assembly of the data, using Pix4Dmapper. The GCP's for night capture are painted with Day-Glo paint colors for bright visibility and identification in the darkness of night.<sup>5</sup>

"The images were then taken into the Sundance Media Group AVOC computers, where we assembled them as a low-resolution 2D file to verify all areas of the scene were adequately captured," said Sam Pepple, of Pix4D. "Once verification and confirmation are complete, the scene may be released to the rest of the CSI team for standard investigation. Following the low-resolution verification, a high-resolution image was processed and evaluated by the team."

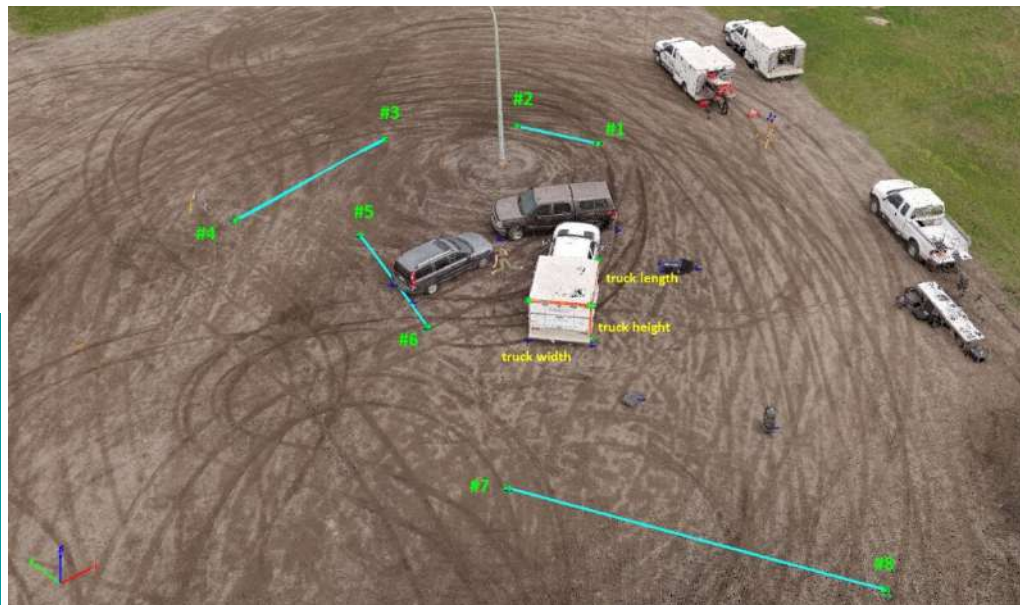
Once the scene is captured, the rectified scene may be viewed internally or via secured online site by CSA, or Crime Scene Analysts, allowing measurements to be verified, retaken, or examined from a multitude of angles.



**Figure 4:** With specially-designed lights, drones can be used at night to capture images.

### Case Closed

Using drones and Pix4Dmapper to reconstruct an accident and crime scenes provide an immediate response, saves time and expense and offers highly accurate outputs.



**Figure 2:** Reconstruction of the collision scene.



**Figure 3:** Processing images with Pix4D drone mapping software.

Generated results are available permanently and actual scenes are preserved in 3D and with detailed information within centimeter accuracy. Users can access files and make measurements anytime when required.

Another advantage of drones and drone mapping allows investigations to be conducted under all weather conditions and provides broader views than traditional procedures. Compared to other precision instruments such as laser scanners, the cost of execution and maintenance of drone mapping is much lower.

- Applies to all conditions.
- Efficient and time saving, immediate response.
- Permanent preservation of data

and reconstructed scene.

- High accuracy for measurements  
Views from all angles, no missing details.
- Easy to operate and maintain, less training needed.
- Both outdoor and indoor reconstruction, seamless merging.

### Reference

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